REPORTS FROM THE HAPLOCHROMIS ECOLOGY SURVEY TEAM

(HEST) OPERATING IN THE MWANZA AREA OF LAKE VICTORIA

33:

PROSPECTS OF THE HAPLOCHROMINE FISHERY IN SOUTHERN LAKE VICTORIA

by

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INTRODUCTION

Research in the sixties revealed that 80% of the demersal fish stock of Lake Victoria consists of haplochromine cichlids (8). In the following decade attempts were made to increase the exploitation-of this vast amount of protein and until recently the fishery on haplochromine fishes was regarded as very promising (4,8). At present, however, there are signs of local overfishing of haplochromine-stocks due to intensive trawl fishery. Moreover, in certain areas the haplochromines have been reduced to very low population levels as a result of the explosive increase of the Nile Perch which heavily predates on these haplochromines (1,10,11; pers.obs.). As a result of these recent developments the prospects of-the haplochromine fishery in Lake Victoria obviously have to be reconsidered.

RESULTS

In the following section a summary is given of research results which are of importance for the fishery on haplochromines. For a major part, the results are based on the research of the Haplochromis Ecology Survey Team (HEST) which over the past seven years has been operating in the Mwanza area of Lake Victoria.

1) Haplochromines can be classified in 11 trophic groups (5,13 ,17) which to some extent can be used as ecological entities (e.g.most zooplanktivores migrate to the water surface during the night, while other trophic groups remain at the bottom (fig.3; 17; Goldschmidt, pers.comm.).

2) Trophic groups are not evenly distributed over the Lake; each area has its own trophic composition (Table I; 13,16,17). In the areas suitable for bottom trawl fishery the four most important trophic groups are detritivores, zooplanktivores, insectivores and molluscivores.

3) Because of ecological (e.g. spawning patterns) and morphological (e.g. size) characteristics of trophic groups, the different trophic composition at various areas (or habitats) of the lake, have consequences for fishery in those areas: e.g. where molluscivores dominate the catches, a larger mesh size should be used than in areas where the smaller detritivores are abundant (c.f. fig.2; 16).

4) Many species are strongly habitat restricted (6,16,17). As a result, overfishing may result from heavy fishing pressure in a restricted area, which then cannot easily be repopulated by migration of fishes from other areas (12).

5) A number of species show migration to spawning areas and to nursery grounds (13,18).

6) Many species important to trawl fishery, have a seasonal breeding pattern and spawn in approximately the same period (figs.4,5; 16,18). This makes it desirable to introduce a closed fishing season.

7) The growth rate of smaller species (adult size 5.0-7.5 cm SL) is approxiately 5-6 cm per year. This means that the generation time of these species approximates one year (fig.6; 16,18). For larger species (e.g. molluscivores and piscivores: Standard Length generally between 10 and 20 cm) the generation time may be longer. The life span of these fishes is not yet known but some of the zooplanktivores seem to live at least 2-3 years (Goldschmidt, pers.comm.).

8) Since the start of the trawl fishery in the Mwanza Gulf in 1973, distinct changes in catch composition of the haplochromines have been observed:

a) The larger haplochromines (SL > 15 cm) virtually disappeared from the catches (Tables II,III; 9,18). This caused a change in the trophic composition.
b) The percentage of detritivores increased at the cost of zooplanktivores (Table V; 18).
c) The mode of the length frequency distribution of small species, such as the detritivore H."nigrofasciatus" (maximum SL 7.5 cm), decreased significantly over the period 1978 until 1982 (fig.7). Over this period the females of this species start breeding at a smaller size than before the increased

fishing pressure (Table IV; 18).

d) The average catch rate per hour decreased from 1753 kg/h in 1976 to 680 kg/h in 1982 (Table VI; 18).

9) Recent trawl catches in the as yet unexploited deep offshore areas (40-60 m) of the Lake revealed catch-rates of approximately 150 kg haplochromines per hour. This is four times as low as the present catch rate of the same trawler in the Mwanza Gulf (4-18 m).

DISCUSSION

Since 1973, when the first trawler started regular fishing activities in the Mwanza area, the trawl fishery gradually increased and at the moment approximately 10 small trawlers (10-15 m; 60-170 hp) are operating in the Mwanza Gulf and its surroundings. As mentioned above this fishery had distinct effects on the composition of the haplochromine stock in the Mwanza Gulf. Similar effects (changes in species composition from large to small species) were observed for demersal cichlid stocks in Lake Nyassa (= Malawi) (14,15). In Lake Nyassa these changes did not seem to affect the catch per effort nor the total yield (15). In the Mwanza Gulf of Lake Victoria the catch per effort of the R.V. Mdiria decreased, but it is not known if and how the total yield changed over the past years. In a trawl fishery on a multispecies stock such as the haplochromines it can hardly be avoided that the larger species are overfished. As a result the trophic composition will change. What effects these changes will have at the long term is difficult to foresee. It might lead to a less efficient ecosystem: i.e. ecosystem overfishing. The indications that the smallest species are also seriously affected by the trawl fishery in the Mwanza Gulf seems more alarming at present. Possibly growth overfishing of even the smallest species occurs. To avoid this larger mesh sizes should be used. The change from a 25- to a 38 mm cod end was reported to have a favourable effect on the cichlid stock of Lake Malawi. After an initial decrease, the catches finally became larger than before this change (Turner and Tweddle, pers.connn.).

Stock recruitment overfishing is also a serious danger for the haplochromine species because the standing stock per species is often low and they produce relatively few eggs (most of the smaller species produce less than 50 eggs per time; pers.ob.; Goldschmidt, pers.connn.) and probably not more than two broods per season can be raised (17). The sensitivity to stock recruitment overfishing may differ from species to species as both the standing stocks of the species and the number of eggs which they produce differ: e.g. zooplanktivores produce approximately half as many eggs as detritivores. ---

The apparent relative decrease of the zooplanktivores in the catch composition in the Mwanza Gulf might be due to such a relatively high sensitivity to stock recruitment overfishing because with the presently used meshes they are probably as much or even less sensitive for growth overfishing as the detriti-phytoplanktivores (zooplanktivores are more slender than detritivores but they mature at a somewhat larger size).

Fishery during the spawning season probably has a negative influence on the haplochromine stock. Haplochromines are mouth brooders, the females carry the eggs approximately three weeks in the mouth. With each brooding female caught, its young are also destroyed. Moreover many species are known to build nests at the bottom of the lake (though it is not certain whether mud dwelling species do the same (6,16). If so, each time a trawl net passes by all nests will be swept away. This may seriously hamper successful spawning. A closed fishing season during the period at which most species breed in a certain area seems desirable.

Although the proposed measures will probably be useful for a number of areas, for other parts of the Lake they are unfortunately rendered out of date by a recent, even more serious danger: the rapidly increasing stock of the Nile Perch (Lates niloticus). This fish was introduced into the Lake at the beginning fishing pressure (Table IV; 18).

d) The average catch rate per hour decreased from 1753 kg/h in 1976 to 680 kg/h in 1982 (Table VI; 18).

9) Recent trawl catches in the as yet unexploited deep offshore areas (40-60 m) of the Lake revealed catch-rates of approximately 150 kg haplochromines per hour. This is four times as low as the present catch rate of the same trawler in the Mwanza Gulf (4-18 m).

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Although the proposed measures will probably be useful for a number of areas, for other parts of the Lake they are unfortunately rendered out of date by a recent, even more serious danger: the rapidly increasing stock of the Nile Perch (Lates niloticus). This fish was introduced into the Lake at the beginning of the sixties (1,11). During the past 7 years a sudden strong increase in catch rate of Lates was observed in the Nyanza Gulf (1,10,11) and subsequently near Ukerewe and in the Speke Gulf (pers.obs.). In a number of habitats of the above mentioned regions haplochromines are almost depleted (1,10,11). Also in the Mwanza Gulf Nile Perch densities increased strongly since--1983 and there is a chance that a large part of the present haplochromine fishery will vanish in the near future. However, many open questions remain: e.g. 1) according to some authors (1,7,11) *Lates niloticus* has a preference for shallow oxygen-rich habitats, but presently it is also found in deeper offshore areas (pers.obs.). It remains the question whether it will be ahle to establish itself in such areas to the same extent as in the shallow Nyanza Gulf. 2) Zooplankton-and phytoplankton-feeders which are partly (or mainly) pelagic might be less sensitive to Nile Perch predation, because it is a demersal fish. Catches from other areas revealed for instance that *Rastrineobola argentea* (dagaa), a pelagic zooplanktivorous cyprinid, is able to coexist with *Lates* (1,7,11). Although for the time being the strong increase of *Lates* seems a favourable development, the final consequences may be very serious for the fish production of the lake. In the first place adding one step to a food chain generally causes an energy loss of 80%. Secondly a large number of haplochromines are primary consumers (detritus and phytoplankton). When these are depleted a major part of the energy input in the Lake may be cut off for fish production. The same holds for food sources like molluscs, that are fed on by specialized haplochromines. The effects mentioned may finally result in a strong decrease of the total fish yield of the Lake.

From the foregoing it will be clear that the haplochromine stock in the Mwanza Gulf will not withstand the pressures of both overfishing and the predation of the Nile Perch. A depletion of the haplochromine stock, the major food source of Nile Perch, must inevitably have its effects on the Nile Perch stock and, at a longer term, on the whole ecosystem. All recent data point to the necessity that measures should be taken although it is difficult to predict the results of these measures. One of the options which should be seriously considered at the moment is to stop the trawl fishery for haplochromines at short notice and instead put a heavy fishing pressure on Nile Perch. This might lead to a system in which not all primary consumers (detriti-phytoplanktivorous haplochromines) are irridicated so that this input to the food chain is not cut off completely. This seems the only way to guarantee reasonable Nile Perch catches at longer terms. If the haplochromine stock is depleted Nile Perch is forced to switch to its own progeny as a food source. This implicates the establishment of an equilibrium at a much lower level. Depending on the results of the suggested measure, it should be decided in a later stage if a limited haplochromine fishery should be introduced again. Whether haplochromine fishery remains possible in other areas of the lake remains to be investigated. Preliminary catch results in the deeper offshore waters (40-60 m) revealed lower catch rates than expected from the earlier trawl surveys of Kudhongania and Cordone (8). The results of these authors show that the catch rates at a depth of 40-60 m were approximately half as high as in the at that time not yet overfished shallow areas. Our preliminary results revealed catch rates that were four times as small as the present catches in shallow water. However: 1) our catch data are all from one month only, it might be that catch rates increase at other periods of the year. 2) The samples were partly made in an area for which Kudhongania and Cordone (8) also found exceptional low catches. Exploration of these deeper offshore areas and other yet uninvestigated areas are obviously needed.

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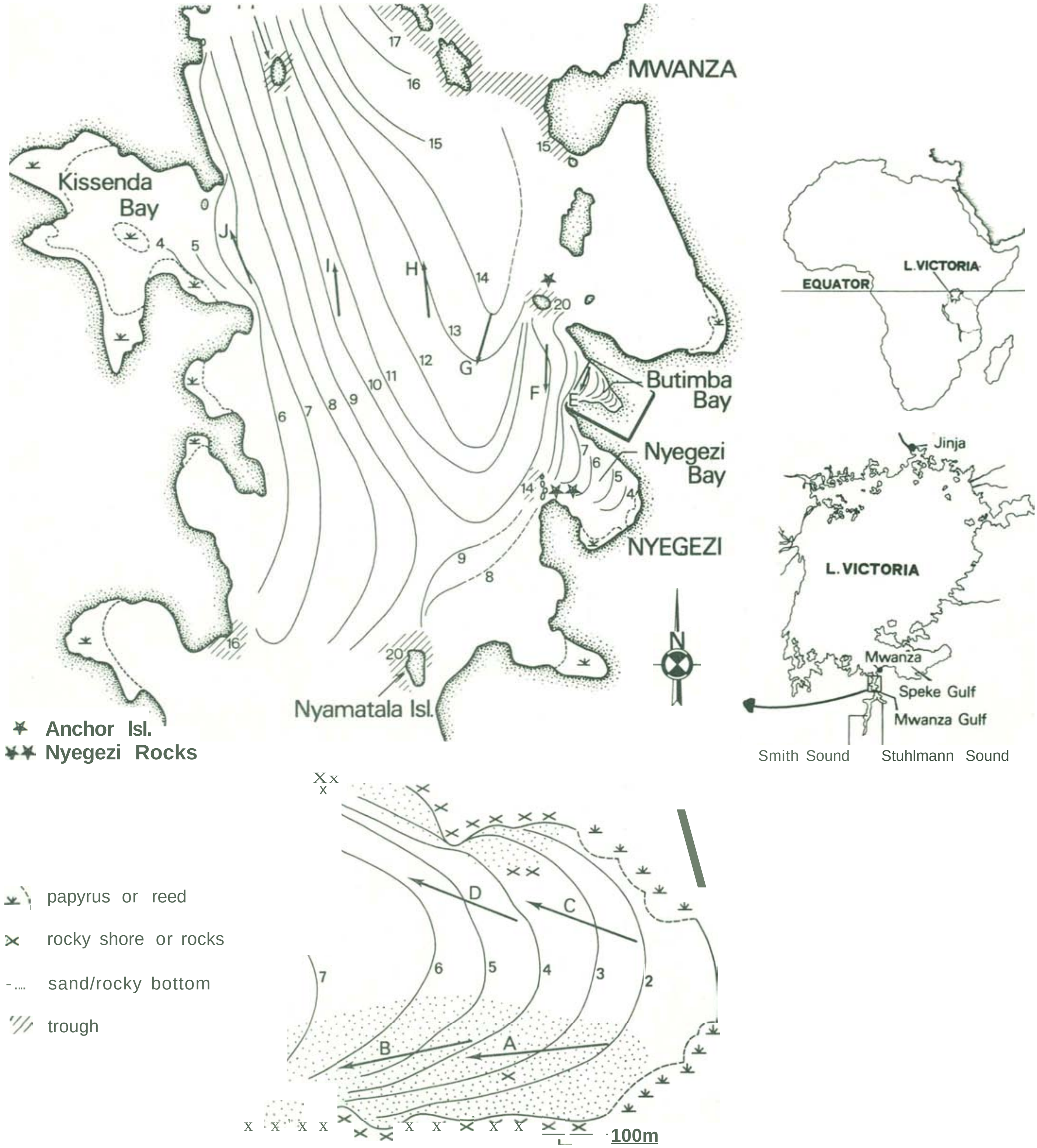

Fig. J. Main sampling area of the Haplochromis Ecology Survey Team (REST) in the Mwanza Gulf of Lake Victoria. Stations A-J were sampled most frequently. Depth contours in meters. Butimba Bay (inset) drawn to a larger scale below. (from Witte, 1981).

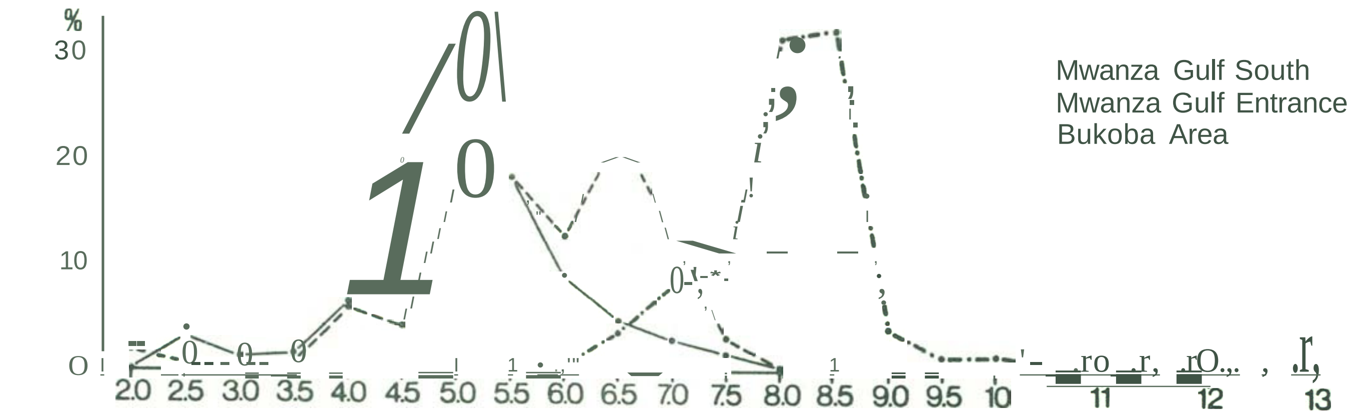

Fig. 2. **Length-frequency** distribution of haplochromine fishes caught with a 19 mm mesh cod **end** in different areas of Lake Victoria.

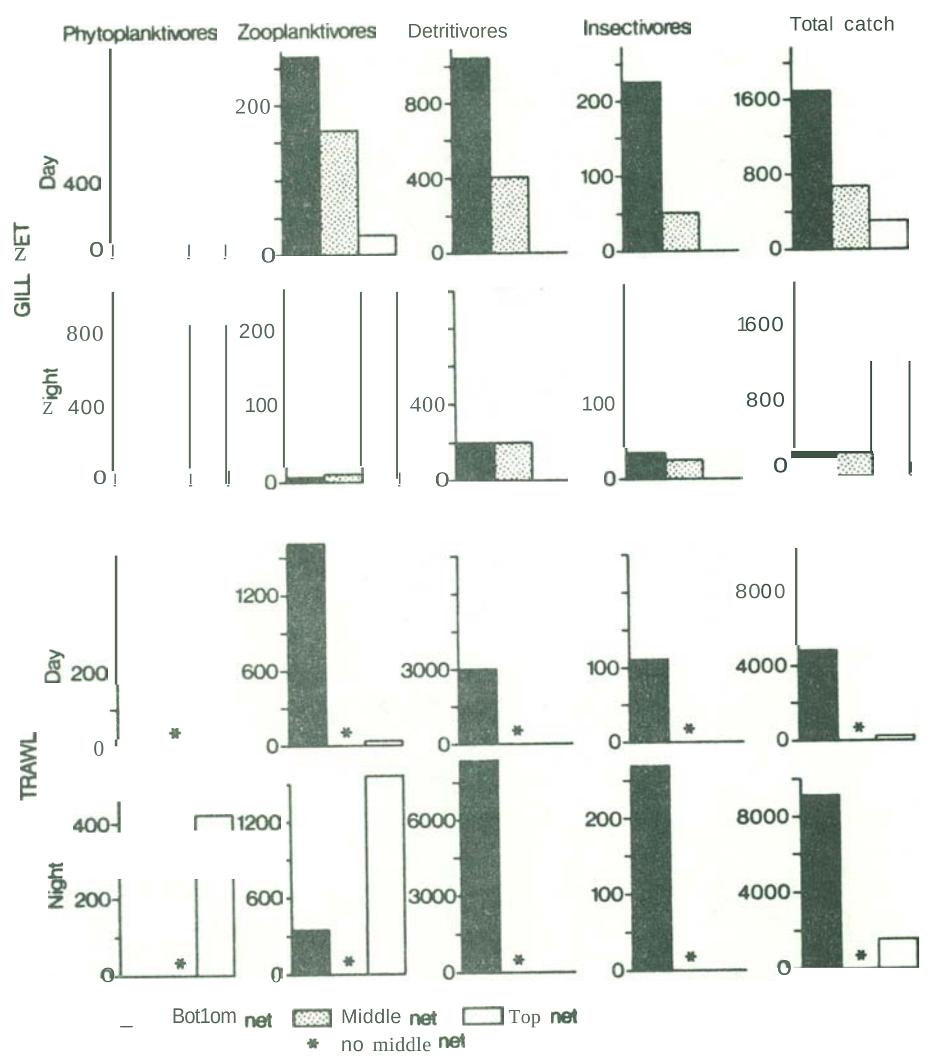

Fig. 3. Total numbers of haplcohromines of the 4 main trophic groupS and of all trophic groups together caught at 8 different day and night catches through 1981 and 1982 at three different levels (bottom. **midwater** and surface) in the water column (station G; see fig.1).

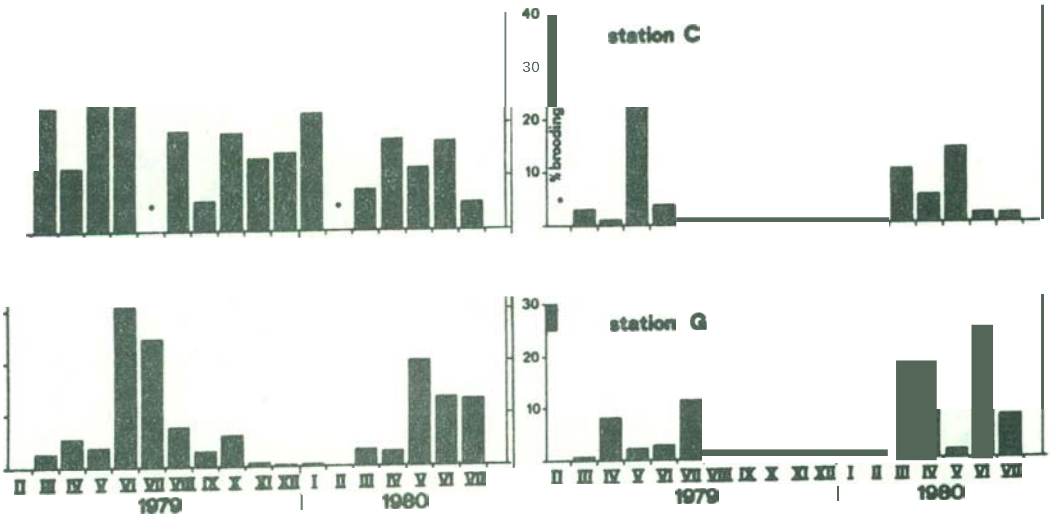

Fig. 4. Percentages of brooding females (number of females with eggs or larvae in mouth, divided by the total number of females) caught at sampling stations A, C, E and G. During the months marked with a point no samples were taken.

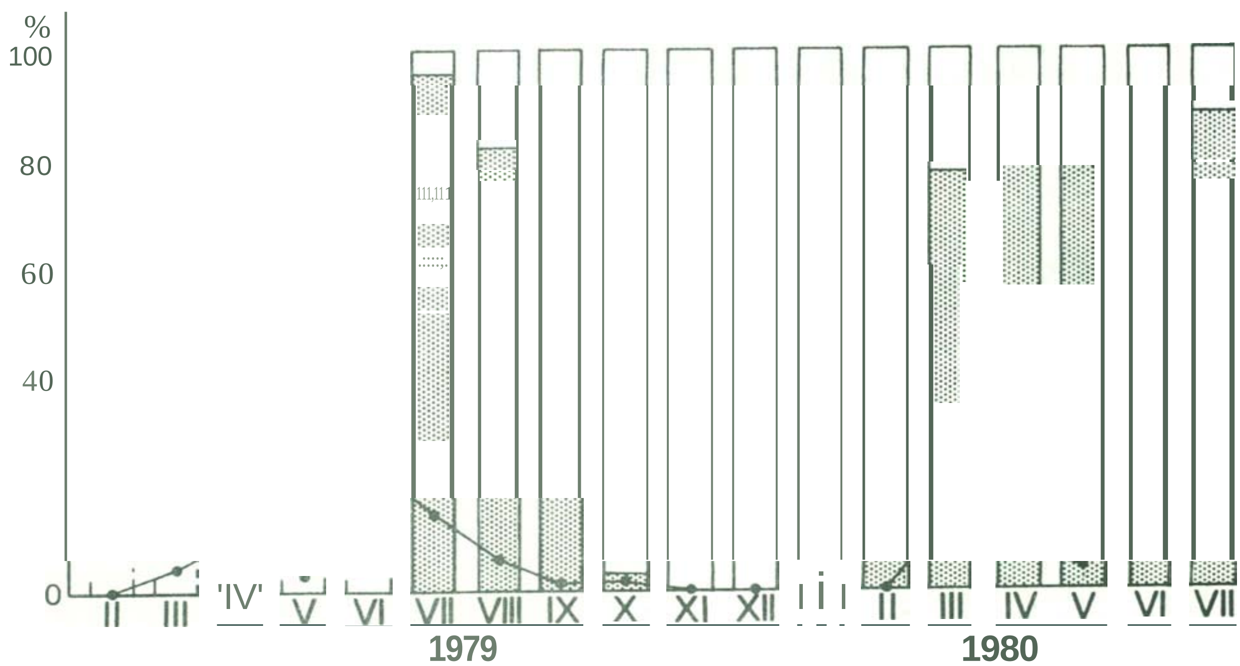

Fig. 5 Percentages of brooding females of H. 'nigrofasciatus" and percentages of brightly coloured (dotted bars) and lightly coloured (white bars) males of the same species. From February through June 1978 no data about male colouration are available.

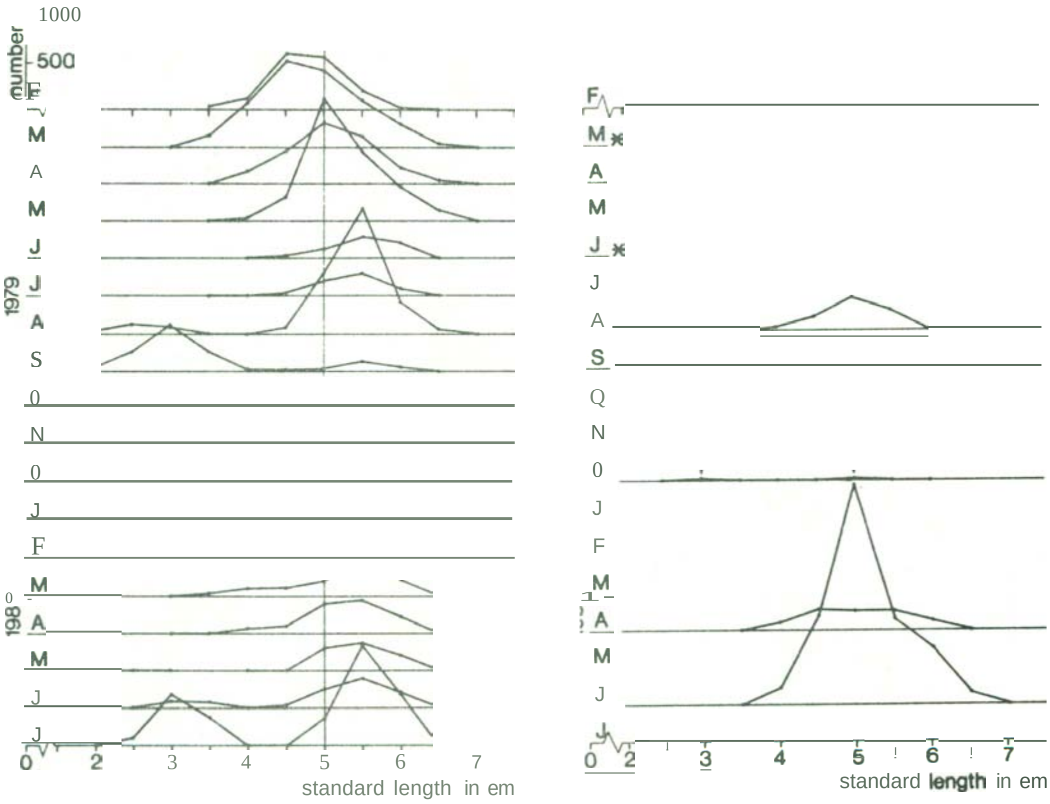

Fig. 6. Length-frequency data of H. "nigrofasciatus". Total number of specimens monthly caught in series of standard catches at stations C, 0, E.F, G (7a) and stations E and G (7b) are presented. Arrows indicate peaks that are not obvious in the figure, because of the small vertical scale used. Note that catch sizes of Fig.7a and b cannot be compared as the numbers of stations and the numbers of hauls per station differ.

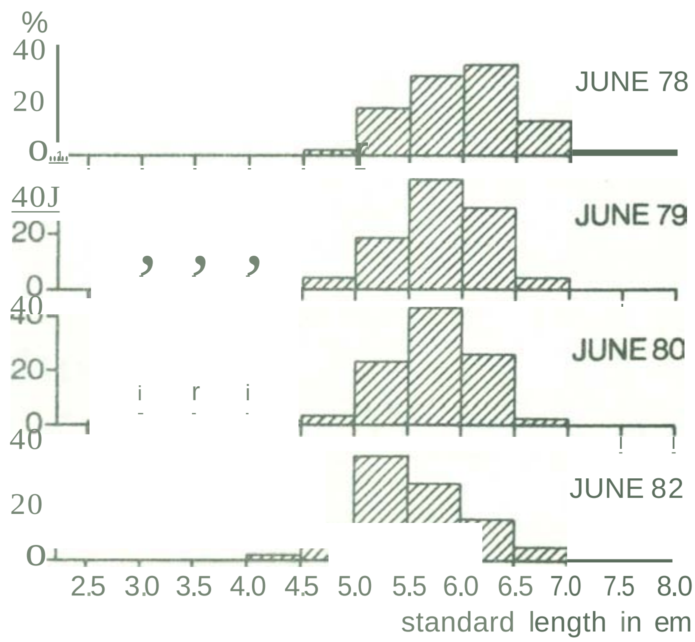

Fig. 7 Length-frequency distribution of H."nigrofasciatus" caught at the research transect in the Hwanza Gulf. Catches in 1978 and 1982 were made with a 20 mm mesh cod end; those in 1979 and 1980 with a 15 mm mesh cod end.

TABLE I

Trophic composition of haplochromine catches (20 mm mesh cod end) in different areas of Lake Victoria. Mean percentages of total numbers and (in addition) for the Mwanza Gulf of total weight are presented.

	Mwanza Gulf 3-16 m 6 trawl shots June-October 1982		Mwanza Gulf Entrance 18-22 m 4 trawl shots April-August 1981	Nafubo Island 8-17 m 2 trawl shots December 1981		Bukoba Area 15-20 m 8 trawl shots February-April 1981
	% of number + s.dev.	% of weight + s.dev.	% of number + s.dev.	% of number		% of number + s.dev.
detriti/phyto-planktivores	77.9 + 4.5	68.6+4.7	75.0 + 5.5	76.1	58.4	
zooplanktivores	19.6 + 5.5	24.3 + 5.0	21.3 + 7.8	16.4	10.7	
insectivores	1.6 + 1.0	4.8 + 3.0	1.9 + 1.2	1.1	1.6	
molluscivores	0.2 + 0.3	0.3 + 0.3	0.2 + 0.2	4.7	25.5	5.5 + 1.6
piscivores	0.4 + 0.1	1.2 + 0.5	0.5 + 0.9	1.1	0.4	1.1 + 0.9
other groups	0.4 + 1.0	0.9 + 2.1	1.6 + 1.5	0.2	3.3	

TABLE II

Decrease of large haplochromines from catches in the Mwanza Gulf (0-19 m depth) with a 89 mm cod end mesh size (from Kukowski, 1978).

Year	1974	1975	1976	1977
% frequency occurrence	85	78	33	9
% of total catch	3	2		+
catch rate kg/hr	8	3		+

TABLE III

Frequency of occurrence of the paedophagous species H.microdon and H."black cryptodon" in trawl catches in the Mwanza Gulf in 1978 and 1982.

period \ occurrence	H.microdon +	H.microdon −	total
1978 Jan.- Aug.	32	8	40
1982 April - July	3	15	18
	35	23	58

χ^2 test $p < 0.001$

period \ occurrence	H."black cryptodon" +	H."black cryptodon" −	total
1978 Jan.- Aug.	25	15	40
1982 April - July	1	17	18
	26	32	58

χ^2 test $p < 0.001$

TABLE IV

Length frequency distribution of brooding females of H."nigrofasciatus" caught in March, April and June 1979 and 1982 at station E and G in the Mwanza Gulf.

Standard length	4.0	4.5	5.0	5.5	6.0	6.5
1979	-	1	3	8	3	1
1982	2	8	7	2	1	-

TABLE V

Mean trophic composition in the Mwanza Gulf from catches in 1978/79 and 1982.

	30 trawl shots Jan. 1978 – Febr. 1979	6 trawl shots June-October 1982
	% of number + s.dev.	
detriti/phyto-planktivores	61.4 + 10.5	77.9 + 4.5
zooplanktivores	30.4 + 12.2	19.6 + 5.5
insectivores	3.1 + 1.7	1.6 + 1.0
molluscivores	0.2 + 0.3	0.2 + 0.3
piscivores	0.7 + 0.6	0.4 + 0.1

TABLE VI

Annual mean catch rates of haplochromines in the Mwanza Gulf, with a 20 mm stretched mesh cod end (depth range 0 - 19 m).

year *	mean catch rate kg/h	catch effort **
1973	1220	≤ 72 hauls
1974	1513	≤ 76 hauls
1975	1532	≤ 137 hauls
1976	1753	≤ 105 hauls
1977	1248	≤ 135 hauls
1982	682	51 I hours

* Data of 1973-1977 from Kukowski (1978).

** Kukowski included also catches from other areas in this table on catch efforts. Most catches were made in the Mwanza Gulf. Tows were conducted for 45-90 minutes.